The animal has been placed in one of the warm tanks in the new Reptile House and appears to be doing well. It is fed principally upon lettuces.

2. An Oriental Phalanger (*Phalanger orientalis*), received March 4th, and presented by C. M. Woodford, Esq., of Sydney.

Out of five specimens of this interesting Marsupial kindly transmitted to the Society by Mr. Woodford, by whom they had been obtained in the Solomon Islands, three survived to reach this country, but of these two unfortunately died before they reached the Society's Gardens.

3. A specimen of Owen's Apteryx (*Apteryx oweni*), presented by Captain C. A. Findlay, of the R.M.S. 'Ruapehu,' on March 5th.

This bird has been placed along with the specimen received on February 19th, 1889, with which it appears to agree well, so that the two are probably a pair.

Mr. A. Smith-Woodward, F.Z.S., exhibited and made remarks on a maxilla of the early Mesozoic Ganoid Fish *Saurichthys* from the Rhætic Formation of Aust Cliff near Bristol.

The following papers were read:—

1. On the Osteology of *Steatornis caripensis*. By W. K. Parker, F.R.S.

[Received March 7, 1889.]

(Plates XVII.–XX.)

Contents.

I. *Introductory Remarks.*

Steatornis is so distinct from every other known bird that it should, if it had its rights, be put into a Family by itself, and thus represent the *Steatornithidæ*[1], of which it is the only existing species. Its distribution is also very limited, being only found in Venezuela and one or two of the neighbouring States.

Nevertheless, this is only one among several of the Neotropical types of birds that have come very near to extinction, there being four or five families which possess at most two or three genera, with very few species.

It is evident that those groups which are most potent in Families,

[1] This has already been proposed by Messrs. Sclater and Salvin, Nomencl. Av. Neotr. p. 97 (1873).

Genera, and Species are the newest and the most specialized; this is seen best of all in the Passerine order, the "Coracomorphæ." On the other hand, we have birds that are impoverished up to the very edge of extinction, such as the "Ratitæ"—poor, stupid, savage tribes, that are fast dying out from among the noble and accomplished modern birds.

The "Order" to which *Steatornis* belongs is in great contrast with the great Passerine group; the Coccygomorphæ are little more than *one fourth* as numerous as the Coracomorphæ, yet are *ten times* as polymorphous.

Among the more than half-myriad of the Singing-birds, using the term in the broadest sense, a very small percentage of the types is abnormal; a very few have four notches to their sternum; two or three genera have their plantar tendons bound across by a special ligament—are Desmodactyle; just a few have a *tracheal*, and a few have a *simple* broncho-tracheal syrinx; whilst two genera, *Atrichia* and *Menura*, have a syrinx that just falls short of the typical perfection of that of the highest form—"the Oscines."

But all these types are Ægithognathous, and, what is most remarkable is, that that peculiar anticipation of the *Mammalian* fore-palate is only found in one small family outside the Coracomorphæ, namely, the Swifts (Cypselidæ).

So that we have *one character which does not fail us* throughout the Passerine order; the sternum, the syrinx, and the plantar tendons are variable. One other character, which, however, is shared by many other birds, is the great *abortion*, mostly the complete *suppression*, of the basipterygoids; these are useful and important things for the taxonomist, but they fail him in the time of need.

The time of need is when he would make a good clear distinction between the Coracomorphæ and the Coccygomorphæ: he is bound to do this, or to cease to call himself a philosophical ornithologist; and yet can it be done?

Here, if anywhere, Professor Huxley's comprehensive terms come to be of great value, but of most difficult application. The difficulty was felt by himself, and he was thus led in his second paper (P. Z. S. 1868, pp. 294–319) to break up and spoil his excellent and most natural group of the "Alectoromorphæ," and a little more wavering of mind would have made him break up and destroy his excellent group of the Cuculines—the Coccygomorphæ. These, however, must be kept together at any cost; to enrich that order I feel willing to give up the importance of the distinctness of the Swifts, the Humming-birds, and the Parrots.

As for the Picidæ and Yungidæ, none but the most fretful and impatient of the *Classifying tribe* would have quarrelled with the present writer for demonstrating the peculiar structure of the palate in these birds, or for inventing a morphological term for that palate, namely "Saurognathous."

As for the value of the condition of this part of the bird's structure, I have just stated that it is the safest thing we have in the Coracomorphæ; but whilst that masterly and invaluable paper on the

Classification of Birds was being written, I pointed out to Professor Huxley that even in the Gallinaceous tribes, which are, more than any other birds, most distinctively "Schizognathous," the larger Curassows, e. g. *Crax globicera*, are "Desmognathous."

I have since that time discovered that *Dicholophus* is directly *Desmognathous*[1].

If we then bind up together some two dozen families of arboreal birds of the *higher*, but not *highest* kinds, and call them "Coccygomorphæ," we must use the palatal character for just what it is worth and no more. If all these troops are to march under the Huxleyan standard, then we shall have the following palatal characters in this mixed multitude of birds:—

SCHIZOGNATHISM.—Trochilidæ, Trogonidæ, Caprimulgidæ (part.).
ÆGITHOGNATHISM.—Cypselidæ.
DESMOGNATHISM.—(*a.* Indirect).—Coliidæ.
(*b.* Imperfect direct).—Capitonidæ.
(*c.* Perfect direct). — Rhamphastidæ and many others.
(*d.* Double).—Bucerotidæ (part.), Steatornithidæ, Podargidæ.
SAUROGNATHISM[2].—Picidæ, Yungidæ.

So, again, with regard to another of the *deep* morphological characters, namely, the arrest or development of the "basipterygoids"; in this character we have the extremest difference, for *Steatornis* is almost Struthious in this respect, and *Cuculus* (amongst others) has these parts aborted as much as in the Passeres, in which they very seldom show a trace in the adult.

Another deep and diagnostic character is the peculiar articulation of the *centra* of the vertebræ, between the *axis* and the sacrum[3]. This, as a rule, is what is called *cylindroidal* by Prof. Huxley, and *heterocœlous* by the American ornithologists. Now it has long been known that many Water and Wading birds have their thoracic or dorsal vertebræ of the archaic type—like those of ancient reptiles, they are *opisthocœlous.* But I long ago showed that Parrots have the same structure, combined with an anticipation of the Mammalian *centrum*, namely with *terminal epiphyses.* But more lately I have discovered that the dorsals of *Steatornis* are opisthocœlous also. This fact has softened down my objection to putting the Parrots along with the other Zygodactyles and their *Syndactyle* relatives; they are not more isolated than the Humming-birds and the Swifts. The manner in

[1] In my paper on the Bird's Skull, Linn. Trans. new series, Zool. vol. i. p. 129, pl. xxv., I have described the palate of this bird as being *imperfectly* desmognathous; the bony union of the "maxillo-palatine plates" is, however, perfect in my specimen.

[2] Strictly speaking the Ægithognathous and the Saurognathous palates are merely *varieties* of the Schizognathous type; that reduces the whole thing to two main kinds—the Schizognathous and the Desmognathous; the "Dromæognathous" condition is merely a retention in the adult of an early embryonic stage.

[3] Proc. Roy. Soc. 1888, pp. 465–482.

which the *leading* modification—the development of the wing—has carried with it, in its special varieties, the rest of the body, subjecting everything else to its domination, is well seen in the difference between *Steatornis* on the one hand, and the Swifts and Humming-birds on the other. The latter are "Macrochires;" their *manus* is of inordinate length and strength, and the *humerus* is very short and strong, like that of a *Mole*. But in *Steatornis* the *manus* is short, the *humerus* long and slender, and the *cubitus* is extremely long: this bird is thus an isomorph in this respect of the aquatic "Longipennes." This great development of the wing, in both cases, has caused a peculiar modification from that of the shorter-winged arboreal types, viz. the ordinary Passeres, and such Cuculines as the Woodpecker, Toucan, and Kingfisher. In all these latter types there is a complete bridge over the top part of the *interosseous space*, formed by one of the intercalary metacarpals—that between the normal 2nd and 3rd; in the embryo of these types another *remnant* appears on the ulnar side of the 3rd, this is a small 4th metacarpal.

Now in birds that habitually flit from tree to tree, having only wings of moderate size, the remains of the primordial fore paw, not wanted in the wing, have a better chance of developing to some extent. Thus the remnant of the *intercalary metacarpal* fused with the functional bars is really large in the adults of these shorter-winged birds. But in *Steatornis*, the Cypselidæ, and the Trochilidæ, the great development of the functional bars has aborted these archaic, non-functional, parts much more. The same thing occurs in other families; in the terrestrial Gallinaceous types the wing is like that of a Sparrow, a Finch, or Crow. In the Swans, Geese, Ducks, Gulls, &c., that is in all birds with long and powerful wings, the intercalary parts are very small, although *nearly always* demonstrable in the early young or in the embryo.

The modification of the *legs*, and with them of the *pelvis*, follows that of the wings and shoulder-girdle; they are not so much modified from a primordial condition as the fore limbs; but they have undergone, nevertheless, a marvellous amount of change.

When *degeneration* of the wings takes place, then the legs become dominant, as in the Ratitæ; that partial descent from a higher platform is correlated with an arrest of the brain.

A very near relationship of *Steatornis* to the Goatsuckers (*Caprimulgidæ*) is rendered somewhat doubtful by the great differences to be seen in certain parts of its structure; its skull and dorsal vertebræ are as unlike as can well be. I suspect that the adaptation of this type to its nocturnal habits has made it much more like the Owls and Fern-Owls than can be accounted for on any theory of descent. If this bird should turn out to be a waif from the ancient tribes of the Caprimulgidæ, and if *Podargus* and its allies belong to the same group, then the true *Schizognathous* Goatsuckers (of the genus *Caprimulgus*) must be considered as a culminating family, in which the whole skull and face has been lightened and refined to a remarkable degree, to give perfection to these crepuscular *Moth-Hawks*. Nitzsch's term for them, namely "Cuculinæ nocturnæ," cannot be improved. Why they should now stand midway between Swifts and Cuckoos must be determined by those who have the power of reading and interpreting the hard sentences of Nature.

Bearing all these difficulties in mind, we may now look into the details of the supposed ancestral form of the Goatsucker type.

II. *The Skull.*

In a large, but evidently rather young, specimen the "rostrum," measured in a straight line, is 29 millim. long; the skull 37·5 millim.

In the skull of a smaller, but older, specimen the measurements are, rostrum 27 millim., skull 35 millim. The bony rostrum (Plate XVII. fig. 1) in both cases is deflected 8 millim. below the general palatal plane; this is seen to a much greater extent when the horny covering is on. Therefore, there is in this case, still more than in *Corythaix*, and other Cuculines with a decurved beak, a *quasi-Raptorial* appearance. Indeed, the skull of *Steatornis* is very much like that of the Ceylon Owl (*Ketupa ceylonensis*); a likeness which is intensified by a similar development of the "basi-pterygoids" in both cases. I believe that this is mere *isomorphism*.

The measurements of the lesser skull are as follows:—

	millim.
Length of rostrum	27
Length of skull, proper	35
Width of fronto-nasal hinge	11
Width of narrowest part of frontal region [1]	12·5
Width across postorbitals	34
Width across occipital wings	31
Width across quadrato-jugal hinges	35

Thus we see that the length and the greatest breadth of the skull, proper, are equal. This at once stamps the skull with an Owl-like character, which is intensified by the narrowness of the upper inter-orbital tract, the large size of the very open orbits (19 millim. long, 16 millim. deep), and the form of the upper beak, or "rostrum." Put side by side with the skull of *Ketupa ceylonensis*, it seems as if it must belong to an allied genus, at least; but in the details of its structure it is soon found to be Cuculine.

The skull of the Ceylon Owl and that of its Strigine congeners, like that of most Diurnal Rapacious birds, is *indirectly Desmognathous*. The skull of *Steatornis*, however, is *doubly Desmognathous* (Plate XVII. fig. 3), and has its alinasals (Plate XVII. figs. 1, 2, *al.n.*) ossified in the true Coccygomorphine fashion; these parts remain cartilaginous in the Owls [2].

[1] In the lesser skull this part is a little wider than in the two large specimens, whilst the surface is gently concave in it, and convex in the larger specimens. Are these *sexual* differences?

[2] There is, I believe, but one point in Ornithology in which I am out of touch with my friend Prof. Alfred Newton. Why he should doubt the near kinship of the Owls to the Harriers and Hawks I cannot imagine; see his remarks in the otherwise unassailable and excellent article "Ornithology," Encycl. Brit. 9th edit. vol. xviii. p. 471.

The culmen of the rostrum in *Steatornis* is subacute (Plate XVII. fig. 2); its dorsal outline forms an almost perfect quadrant, it is somewhat wavy, and drops suddenly near the hinge, which is straight across the skull, and is perfect. The nostrils (figs. 1, 2, *e.n.*) are in front of the middle of the rostrum, reniform, oblique, and 6 millim. long; a small alinasal valve, covered by the ossified roof, forms the "hilus" of the kidney-shaped opening.

These ossified roof-cartilages (*al.n.*) are full of vascular borings, which give them a different appearance to the nasals and premaxillaries (*n.*, *px.*). But the fusion (ankylosis) of these parts is perfect, and so also is that of the ossified *septum nasi*, with the surrounding bones. That wall has in its middle a large pyriform fenestra, 4 millim. long and 3 millim. deep, a structure more frequent in Aquatic and Grallatorial birds than in the higher Arboreal types. This is one of its aberrant characters; the inferior turbinal (right and left) remains unossified. Under the bulging alinasal tracts there is a gently concave, wide sulcus, which ends in an open space between the rostrum and the ectoethmoid (*pars plana*). At this part of the skull the angles of the maxillaries (figs. 2, 3, *mx.*) are 20 millim. apart; and close here, in the hollow behind the descending crus of the nasal, the projecting maxillo-palatine (figs. 1–3, *mx.p.*) is seen, right and left.

This lateral rostro-cranial space should be largely filled in by the lacrymal (fig. 1, *l.*), which is so constantly large with a considerable frontal suture, and a broad supraorbital tract, in the Cuculines generally. Here, however, in *Steatornis*, it is very small, and is ankylosed to the nasal, forming a small projection, 3 millim. in extent, to the postero-superior edge of the rostrum. This condition of things is very common in such Passeres as possess a small lacrymal; in the Corvidæ, Laniidæ, and some others it is pupiform and free.

In the Woodpecker (*Gecinus viridis*), and in that marvellously aberrant Fowl, *Opisthocomus*, the same thing is seen; the lacrymal being very small, and ankylosed to the nasal.

The margin of the rostrum is cultrate, and the dentary edge is separated by a groove from the palatine face of this region; the middle is gently ridged, and this ridge passes into the ossified *septum nasi* (*s.n.*), which in its fore half is marked off by a right and left chink. In its hinder half it is higher than, but ankylosed to, the maxillo-palatines (*mx.p.*), which swell downwards, right and left, and have a notched hinder margin. Between these parts there is another sharp notch, filled in, in front, by the bony nasal septum. The outer notches as well as the inner are in front of the maxillary angles, and the whole posterior palatal margin of the rostrum is thus strongly serrate.

The maxillo-palatines (fig. 3, *mx.p.*) are only moderately high and spongy; under their thickest part the prepalatine laths (*pa.*) pass forward and are ankylosed to them. The fibrous fore part of the prepalatines reaches as far forwards as the middle of the septum nasi; where they escape from under the maxillo-palatines they are

3 millim. across, and together take up a space of 11 millim., measured across. They then narrow in to 2·5 millim. and enclose an oval common "middle palatine foramen" or open space 9 millim. long and 6 millim. wide; the fore end of this space is enclosed by the maxillo-palatines and septum nasi, and is, indeed, the *middle notch* just spoken of. This space is enclosed behind by the two palatines, which meet and form an oblique suture 1·5 millim. in extent.

This *second part* of the hard palate in this "doubly Desmognathous" bird is 8 millim. across; behind it the palatines narrow in again, until their lower part is a mere ridge; but they have curled round now, and formed the low and short "ethmopalatine," or ascending processes, which run under the sphenoidal rostrum for a distance of 6 millim., and are ankylosed together. Behind, the two coalesced palatines are only 3·3 millim. across, where they articulate with the pterygoid. The outer edge of each palatine is sharp, not limbate; it is bevelled into an edge from the sub-mesial thickest part.

I have spoken of the prepalatine bars as *laths*; the middle and hinder part is like a *shaving*, coiled obliquely, so that the edges of the two bones meet below, in front, and above, in their hind part. They thus enclose the naso-palatine passages (*i.n.*), flooring them in front for a short distance, and then roofing them, behind, for three times that extent. The concave opening of these passages behind the short posterior hard palate is elliptical, 9 millim. by 4·5 millim. The edge of the two bones enclosing this space is limbate, and corresponds with the inner edge of a *grooved palatine bone*; here, there is no groove, but the bone curls upwards at once, to pass into the ascending plate. This is much more *primitive*, or simple, than what is seen in the Trogons, where they do not unite to form a second part of a hard palate, and have a *groove* and some angulation of their outer edge.

Steatornis has two vomers (*v.*), each 5·5 millim. long and 1 millim. wide; they are sharp at both ends. The hinder bone has had its distinctness obliterated by ankylosis; it is probably a "mediopalatine," like that seen in *Caprimulgus*, Owls, &c.; this vomerine bone, now, forms merely an upper, partial septum between the naso-palatine passages. In a membranous tract in front of the triangular end of the fused vomer there is, at a little distance, a similar bony tract—an "antero-median vomer." The supero-external edge of each palatine, for an extent of 3–5 millim., is formed by the "mesopterygoid" increment; so that the short *trough*, 4 millim. in extent, in which the sphenoidal rostrum (*pa.s.*) lies, is formed by three pairs of bones; that rostrum runs free of this groove for 7·5 millim., its projecting point is 3 millim. behind the vertical line of the hinge, and of the notched hind edge of the septum nasi. It is extremely unlike an Owl in this respect, in which bird the *hinge-notch* is shallow and of great extent; the rostrum of the sphenoid ends much further backwards in that bird, having no projecting spike in front. The hind part of the sphenoidal rostrum, with its basipterygoid processes (*b.pg.*), may be described now, because of the relation of the latter to the pterygoids.

In the large specimens the basipterygoids have a facet for their *perfect joint* with the pterygoids 4–5 millim. in extent; these two oblongo-oval condyloid tracts are 8 millim. across in front, and 11 millim. behind; they are wider proximally than at their articular face, and project 2 millim. at their hinder notched margin. The sphenoidal rostrum is 5·5 millim. wide between their fore part, and 2 millim. over the palatine groove.

The pterygoids (*pg.*) are 11 millim. long, and measure from 1·5 millim. to 2·5 millim. in breadth. They approxmiate at a few degrees more than a right angle; in the Trogon, at a few degrees less; this greater divergence is due to the general extension in breadth of the hind skull; and the same thing is seen in Owls. The fore part of the pterygoid is oblique and tridentate, it overlaps the palatine; the epipterygoid forms a low triangle; the whole bar is arched upwards, and the bone is smooth and strong. The facet for the basipterygoid is in the middle of the shaft, and lies mainly outside an ascending flange of the bone, so that it works outside the fixed condyloid facet of the basipterygoid; it is only two thirds the length of that fixed facet, and moves beyond it, in front and behind. Thus the *capsular* ligament must be loose and elastic, as in the oblique facets in the mid-region of the neck of *Buceros* and other Cuculines.

The palatines are set on more suddenly to the "rostrum," or upper beak, than in the Trogon, where, however, they are not *hinged*; they are not hinged in *Corythaix*, but the jugals are.

These latter bones are not hinged in *Steatornis* (Plate XVII. fig. 3, *j*) and are very slender; first depressed, where they begin at the fore part of the jugal process of the maxillary, and then compressed, where they approach the quadrate, into which they fit by *gomphosis*. The hinder part of this jugal bar is formed by the quadrato-jugal (*q.j.*). The three elements of this feeble cheek are all ankylosed into one elastic needle of bone, which, in the middle, is only 6·5 millim. thick. The quadrate (*q.*) is a well-formed normal bone, in harmony with the Owl-like breadth of the hind skull; the setting on of the double hinge, or "otic process," is wide and transverse, the inner head being only about 2·5 millim. behind the outer. In the large *Strix* (*Ketupa*) *ceylonensis* these "heads" of the otic process are 12·5 millim. across; in *Steatornis* 7 millim.; in *Corythaix* 5 millim. Relatively to the size of the skull, *Steatornis* has its otic process nearly as wide as in the Owl. The quadrate has an average "orbital process;" it is oblique and pedate, and its body is deep and rather square; the cup for the end of the jugal bar is neat and pedunculate; the knob for the end of the pterygoid is well-formed; and the inferior condyle, as usual, is double.

This latter part has a hinder *trochlea* looking inwards and backwards, and an anterior oval, convex condyloid tract which is in a line with the oblique pterygoid, and just reaches its joint, which is a cup and ball.

The action of a palate like this is somewhat less rapid, and the parts themselves are much lighter and slenderer, than in many of the Cuculines, or in the Parrots, generally. This part is rather weak in *Steatornis*; in this respect also it resembles the Owls. But it is evident that they can exert a considerable amount of force in tearing to pieces the fruits on which they feed; about equal, perhaps, to that of which an Owl is capable, whose food, however, is not ripe fruit, but small living vertebrates.

Before finishing my description of the oral apparatus, there are several things to be mentioned in the upper and hinder parts of the skull proper; besides the "remnants" of the *larval palatines*, or *ossa uncinata*.

These latter structures (Plate XVII. figs. 1–3, *o.u.*) are attached to—grow directly out of—the hind wall of the nasal capsule (*pars plana*, or ectoethmoid, *p.p.*). The whole of this wall is an oblique tract of bone 9 millim. deep and 5 millim. wide; it is notched deeply in its fore edge, at the middle; the part above the notch is the aliethmoid" (*al.e.*), the back part of the region of the upper turbinals; and the lower part, or *pars plana*, is the back of the middle turbinal region. There are no special turbinal coils to increase the surface for the distribution of the 1st, or olfactory nerve; the aliethmoid merely forms a semicylindrical fold, which runs inwards and forwards from the notch between the upper and lower regions. The aliethmoid is confluent above with the frontal roof, and behind it there is a trilobate fenestra, 6 millim. long and 3 millim. deep. This latter space is the membranous representative of the outer wall of the cribriform plate of a Mammal; the olfactory crus (I.) runs along through it to the simple nasal labyrinth. In all these things this bird is *normally ornithic*. The olfactory crura are separated by the thick top of the mesethmoidal partition wall (*p.e.*), the fore edge of which forms the hinder boundary of the great notch, which gives rise to—makes possible—the *fronto-nasal hinge*. The aliethmoid, at its ankylosis with the frontal roof, is grooved by the ophthalmic, or orbito-nasal nerve, which runs, outside the olfactory crus, into the nasal labyrinth, to supply its antero-inferior region, to which the nerve of smell does not come. On the right side one, on the left two, small perforations are seen at the root of the pars plana.

Now this ectoethmoid (pars plana) *is continuous with* the anterior crus of the cartilaginous palato-quadrate arch in the Tadpole, and also in the adult Frog: in the Salmon and other Teleostei, and also in the Urodeles, this crus *articulates* with the ectoethmoid. The fore part of that arch is naturally divisible into three regions, namely—the *ethmo-palatine, pre-palatine*, and *post-palatine*. Here in *Steatornis*, and also in *Todus*, the part called the "os uncinatum"—so well known in Musophagidæ—is triradiate; thus it has all the *three* regions seen in its homologue in the Ichthyopsida. Of course it is small, and degenerates into membrane at the end of its rays; but it is an extremely archaic,—a truly primitive structure, and is built up amongst the *newer, functional* parts of the palate. In passing, I may state my experience of the presence of this almost functionless *remnant*. It is well developed in *Steatornis, Todus*, the Musophagidæ generally, in *Scythrops*, where it is very large and perfect, and in *Piaya cayana*, where it is a simple vertical needle of bone; is large in the Raptorial *Dicholophus*, and also in the Procellariidæ. In the Laridæ it is smaller, and in the Alcidæ (*Alca torda*, *Uria troile*) it is a mere rudiment composed of one or two independent bony nuclei at the infero-external angle of the pars plana[1].

It is worthy of remark that the palato-quadrate arcade of the Ichthyopsida, although appearing *here* and *there* at *hap-hazard*, as it were, in the families, shows one part in the birds just mentioned, and another in the Passerines. In these latter birds I have found no *distinct* "os uncinatum," merely a knob or outgrowth of the pars plana representing that bone. But in all these culminating types there is a special apparent outgrowth of the palatine bone at its postero-external angle (see Trans. Zool. Soc. vol. ix. pl. lv. figs. 1, 5, 6, and 13, *t.pa.*); this is formed by the independent ossification of a considerable part of true hyaline cartilage, which is in reality the reappearance of the horizontal part of the "palato-quadrate" bar of the Ichthyopsida. In *Steatornis* the form of the "os uncinatum" (*o.u.*) is that of an inverted T: the stem is attached to the antero-inferior edge of the pars plana, the front ray runs upon and is attached to the angle of the maxillary, and the hind crus is attached to the inner edge of its jugal process. In contemplating these things we are let down, so to speak, not merely to the *Reptilian*, but to the *larval Amphibian* level. The supraorbital chain of bones, seen in the Tinamous and some other binds, the sutures in the skulls of those Gallo-struthious birds, and the opisthocœlian dorsal vertebræ of many birds, only let us down to the *Reptilian level.*

But the "os uncinatum," the post-palatine, and the remarkable *squamosal* of the Ratitæ—the true representative of the "temporo-mastoid" of the Amphibia—*squamosal and preopercular* in one, these structures show that the ancestors of the bird-kind were once on the lower Ichthyopsidan level.

They could not, at that time, have been in a *feathered stage*; that form of covering cannot be imagined as clothing a kind of *Tadpole*; but *a kind of Tadpole* my have undergone metamorphosis into a creature whose clothing was of feathers.

The free edge of the perpendicular ethmoid (*p.e.*), behind the notch, has a convex outline above, and a concave outline below; the parasphenoidal rostrum (*pa.s.*) (Plate XVII. figs. 1 and 3) projects forwards here as a sharp spike; that grooved beam forms a common basis to the perpendicular ethmoid in front, and to the basisphenoid behind; the presphenoid (*p.s.*) is tilted up above their junction, as in birds generally. The orbito-sphenoids (*o.s.*) are scarcely developed as distinct alæ. The interorbital wall, made up of all these parts, is completely ossified and is moderately thick. The orbital rim ends behind in a triangular postorbital process 5 millim. in extent; it is over the notch leading to the moderately shallow, concave, temporal fossa (*t.f.*), which is only 5 millim. from its fellow of the opposite side, and is 10 millim. broad below.

[1] Proc. Roy. Soc. 1888, pp. 394–402.

There is no zygomatic snag to the *squamosal*, which at its anterior corner clamps a very short "sphenotic process" of the alisphenoid. The bone in front of the squamosal and sphenotic, formed above by the frontal, and below by the alisphenoid, makes a perfect back-wall to the orbit, and floor to the tilted cranial cavity; this is a *closed*, not a *fenestrate* skull. The low, smooth, wide occipital plane (Plate XVIII. fig. 1) is emarginate above, and slants backwards, so as to form an obtuse angle with the base. The foramen magnum (*f.m.*) is pyriform, with the narrow end above; the condyle (*oc.c.*) is reniform and transverse, 2 millim. by 1·3 millim. in size. Where the basitemporals (Plate XVII. fig. 3, *b.t.*) are fused with the upper outgrowths of the basisphenoid, to form the openings of the "anterior tympanic recesses," there they are 18 millim. across; behind they are 13 millim. wide, and their average width is 3 millim.,—very narrow as compared with the great, massive, triangular plate formed by these two bones in Geese and Fowls. In front they form a projecting lip, and a narrow tongue of bone grows from the middle of this neat lip under the common Eustachian vestibule (*Eu.*); the openings into the right and left tubes are 3 millim. apart. The opening of the tympanic cavity (*ty.c.*) is partly protected in front by a pair of distinct tympanic bones (*ty.*, *ty'.*), the size of these is very small. The entrance to the tympanic cavity is very large, but it is greatly overshadowed by the quadratum in front, and obliquely half-closed by the "tympanic wing" of the exoccipital (*t.eo.*) behind. That wing, which runs obliquely forwards, inwards, and downwards, has an *f*-shaped front edge, concave above, and rounded below; its back face, the outer edge of the *occipital plane*, is plano-convex. This wing is 10 millim. in extent, and the right and left wings are only 13 millim. apart along their inner edge. The whole breadth across the occipital plane, over the top of the tympanic wings, is 31 millim. Laterally these wing-like *outgrowths* enclose the hinder basi-cranial territory, which is margined with passages for the internal carotid arteries (*i.c.*), the vagus and glosso-pharyngeal nerves (X.), the hypoglossal nerves (XII.), and some small veins; all these passages are normal in *Steatornis*. The back of the quadrate is concave above, and then bulges backwards; thus the tympanic entrance is, at first, 3 millim., and then only 2 millim. wide.

Inside that narrow, oblique, high doorway there is the most confusing multiplicity of passages leading into the outer and inner chambers of the auditory labyrinth. The *middle ear* or tympanic cavity is as complex as in the Crocodile, but after a different fashion; whilst the inner ear or membranous labyrinth is enclosed in cavities, tubular and ventricose, very similar to those of the higher *modern* reptiles. Behind and between the crura of the otic process of the quadrate there is the opening into the "upper tympanic recess," and in front of that double condyle the Eustachian openings; and behind and more inwards there is a common vestibular opening leading to the *fenestra ovalis* and *f. rotunda*.

All these tympanic openings lie in the mouth of a trumpet-shaped cavity, formed by the wings of the basisphenoid above, and the basitemporal plate below; this conical cavity is the "anterior tympanic recess."

All these parts of the ornithic auditory labyrinth are well seen in *Steatornis*.

The mandibles (Plate XVII. figs. 1 and 4) form a remarkable structure, being narrow and pointed in front, and extremely wide and bowed out at their hinder third. Behind, they curve inwards again, so that their "internal angular processes" are only 15 millim. apart, whilst the width across the broad part is 33 millim., the rami being 57 millim. long, and their ankylosed symphysis 5 millim. in extent, and their oblique hind edge 5 millim. high. Behind, in the coronoid region, near the hinder part of the dentary, and again at the fork of that bone, where there is a snag for muscular attachment, the bone is 7 millim. high. Under the first of these high tracts the outer face is hollow, but the hind part of each ramus is swollen and pneumatic, and there is a large foramen for the "siphonium," on the top of the "internal angular process." The sutures are nearly filled in; there is a large oblique dentary canal under the coronoid process. The hinder or articular part is wide and triangular; there is a deep sinuous hollow between the cartilaginous condyloid tracts, the outer of which is pyriform and convexo-angular, and looks forwards and inwards, 5 millim. long; whilst the inner condyloid face is a semicylindrical trough, with sharp sides; it looks more inwards than the outer condyloid facet; this scooped space is 2 millim. wide, 2·5 millim. long, and 1·5 millim. deep. The perforated internal angular process is blunt, turns upwards, and extends 2 millim. inwards from the condyloid trough. The motions of a jaw so hinged must have some peculiarity—there is so great an appearance of *art* in its convexities, concavities, sinuosities, and directions; the result of all this careful adaptive specialization would seem to be a perfect combination of elasticity and mobility with strength,—strength sufficient for the purposes of this frugivorous bird. Notwithstanding the large size of the socket, the eyeball, *like that of Opisthocomus*, is small; its largest diameter is 16 millim., and that of the sclerotal ring is 12 millim.; the largest plates are only 2 millim. wide, and there are 14 of them, as in *Gecinus viridis*; but in that bird they are much more elegantly formed, and 3·5 millim. wide; and they are neatly turned outwards at the inner edge of the rim; in *Steatornis* they are almost flat, just a little concave externally, and are very similar to those of a Monitor Lizard (*Psammosaurus griseus*). In another evening bird not much larger than *Steatornis*, namely, the Hooting Owl (*Strix aluco*), the eyeball is 25 millim. across, and the 15 sclerotals vary from 8 to 12 millim. in width outwards, and are about 6 millim. in extent at the outer rim, although much of this is overlapped in most of them.

The *hyoid arch* (Plate XVIII. fig. 2) is normal, but rather feeble. The tongue is short and sagittiform, and in it the cerato-hyals (*c.hy.*) converge and unite in front; they remain unossified; their length is 12 millim. The basal bar (*b.h.br.*) is of the same length; it is moderately dilated where the posterior cornua (*cornua majora*, br^1.)

articulate with it, and the distal free end is narrow, terete; it is ossified, proximally, by a separate centre. The posterior cornua are 31 millim. long; they are feeble, rather straight, and the upper piece, which is 11 millim. long, has its distal half cartilaginous.

III. *The Vertebral Chain and Ribs.*

The vertebral formula of this bird is as follows:—C. 15, with 3 pairs of ribs, free, on the left, and 4 on the right side; D. 4; S. 13, the first with large free ribs, this and the next two, with arrested ribs, buttress the *pre-ilia*; the 13th vertebra not firmly ankylosed to the 12th; Cd. 7+4 or 5, = Total 43 or 44.

The *procœlous* articular facet of the *atlas* (Plate XIX. fig. 1, *at.*) is somewhat transverse, and this cup is largely *notched* for the odontoid process of the *axis* (Plate XVIII. fig. 3); not *perforated* as in most of the high arboreal birds. The atlas has no lateral passages for the vertebral artery; its *centrum* articulates with the *axis* by the normal *flat* facet. The odontoid process of the axis is large (Plate XVIII. fig. 4); this bone (Plate XIX. fig. 1, *ax.*) has thick, blunt upper and lower spines, and oblique ascending snags over the post-zygapophyses; a pair of small upper *fenestræ*, and, what is very rare in birds, well-formed *rib-bars* (*cr*^{2}.) to enclose the canal for the vertebral artery; the articulation of the centra throughout the rest of this region is *cylindroidal*. The 3rd cervical (Plate XIX. fig. 1) has also blunt upper and lower spines, lateral fenestræ, above, a wide top, and a definite snag over each post-zygapophysis, and a rudimentary rib, right and left, bounding the canal for the vertebral artery; this part is 3·5 millim. long.

The 4th cervical (Plate XIX. fig. 1) has its sides notched, not fenestrate; it has both upper and lower spines, somewhat larger riblets, and spines on the post-zygapophyses.

The 5th cervical is much like the next four or five; but in this *strong chain* of bones each succeeding vertebra is larger and stronger than the one in front of it; towards the chest they become shorter, as well as wider. This 5th bone, like the rest up to the 12th, has large riblets; on the 5th, 6th, and 7th these *styles* reach back within 2 millim. of the end of the centrum. None of these vertebræ have the inferior or carotid canal developed, for the inferior face is wide open and gently concave in front; at the middle they are subcarinate, and flat behind, where they broaden out into the apparently convex, but really concave, hinder facet. The wide canal for the vertebral artery, right and left, is only complete in the front third of each vertebra, and only on the 10th, 11th, and 12th is there any rudiment of the oblique bar (or flying buttress) so common in the Coccygomorphæ, a growth that partially finishes the lateral bony wall. I have mentioned that the 3rd has large lateral holes above, and that the 4th is notched, and not fenestrate. The 5th also is notched on its outer and upper edge; but the hinder margin of each notch is developed into an oblique, bony bar, which, running forwards, inwards, and upwards, forms by union with its fellow a small spine that looks forwards; this structure is seen, but not so well, in the 6th and 7th, and then dies out.

The 6th is the longest of the series; it is 13·3 millim. long, and 11 millim. wide, over the pre-zygapophysis. The 9th and 10th have oval knobs on their post-zygapophyses. The upper spine begins again on the 12th, on the 14th it is oblong and large like those of the dorsals, but smaller; in the 15th it is three fourths the size of those on the dorsals. The last six cervicals have a small inferior spine; this is trifid in the 14th, and is dilated into a broad plate in the last. The 13th has a small, free, V-shaped rib; in the 14th the *left* rib is very slender, but it is 22 millim. long, whilst its *right* rib is only 7 millim. long. On the *right* side the 12th has a V-shaped, distinct rib. The last cervical only differs from a dorsal in having no sternal piece; it has the uncinate process or bone (this is a distinct element), and is nearly as long in the 1st dorsal. The posterior part of this 15th vertebra is intermediate in character between cylindroidal and opisthocœlous. My memory fails me in endeavouring to think of any other existing bird *with more than three distinct ribs in the cervical region*, even on one side; there is often a want of symmetry in this part of the spine, as well as in other parts, *e.g.*, *atlas, sacrals*, &c. This fact—that, at least on one side, *four ribs* remain free in the lower part of the neck—coupled with what I shall now show as to the structure of the dorsal vertebræ, gives me the right to say that this is a very archaic or *quasi-reptilian* type.

The four dorsal vertebræ have very long and sharp upper spines, and the first two have, also, simple lower spines; the dilated plate seen in the last cervical has died out, and the process itself greatly elongated, downwards. The front face of the 1st dorsal centrum is cylindroidal, the rest of the articulations of the dorsals and the last dorsal with the 1st sacral is *opisthocœlous*. The centra are narrow, almost Chelonian in this respect, the 1st and 2nd are *mere keels*.

The posterior cup of each dorsal centrum is well excavated, and there is, right and left, at its upper part, a pair of semi-oval enlargements of this facet, that look like *an additional pair of zygapophyses*; hence, on the side view, the outline of the hollow end of each centrum is deeply notched at its upper third. Each of these *secondary facets* has its own concavity, so that each centrum fits to the one behind it by three hollow facets, one large, below, and two small, above; the articular cartilage is very thick in these vertebræ. Thus, although this mode of articulation is archaic, it is also intensely specialized by this modification (Plate XVIII. figs. 5, 6).

Up to the present, this is the only Cuculine type, *except the Psittacidæ*, in which I have found the dorsals to be opisthocœlous. It is common among Water[1] and Wading birds.

The *ribs* (Plate XIX. fig. 1) are very peculiar; they resemble those of the Hornbills, but the peculiarity seen in those birds is exaggerated in this. This is worth considering, as we have just

[1] The secondary facets just described are not so distinct in Parrots and Plovers as in *Steatornis*, which is equal to *Chionis* in this respect.

seen how Bucerine the palate is. This *isomorphism*, however, has to be taken for what it is worth; it is very limited, and in the great Cuculine group (Coccygomorphæ) we everywhere meet with characters in one Family that correspond in some degree with those in another, where everything else is very unlike. This is to be noted in the contrast seen between the dorsal vertebræ of the Bucerotidæ and those of *Steatornis*. In the former they are cylindroidal, and very broad, widened, and flat below; those of the latter run into a mere keel. Also, in the Bucerotidæ the spines in the dorsals form a feeble *saddle-backed* series, having a concave general outline; in *Steatornis* they form a strong straight series, and the interspaces between the spines are very small. In a New-World Kingfisher (*Ceryle alcyon*) the hinder dorsal centra make a great approach to those of *Steatornis*, without, however, being opisthocœlous.

The peculiarity just referred to in the ribs is their great breadth above, their narrowness below, and the low position of the uncinate processes (*p.u.*). The second pair are the widest; they are 6 millim. across for some distance below the tuberculum, and only 3 millim. near the lower condyle; the processus uncinatus is only 11·5 millim. at its base, above that, the condyle is 13 millim. long, and has an average breadth of 2·5 millim. The 1st sacral has a pair of ribs which have a sternal piece, imperfect, but 17 millim. long. The 1st dorsal sternal piece is 14 millim., the last 28 millim. long; they have an average width of 2 millim. The *sacral vertebræ* and the whole pelvis (Plate XIX. figs. 2, 3, and Plate XX. fig. 6) are very much like those of *Ceryle alcyon*,—the Kingfisher whose dorsals show a tendency to the opisthocœlous character, and have deep, concave-sided dorsal centra, with long, basally-dilated, inferior spines. As in that bird and the Hornbills the sacrum is completely ankylosed to the iliac bones, even in the young bird of the first year. This perfect union of the lateral with the median elements of the pelvis is seen in the Common Cuckoo (*Cuculus canorus*) in young birds of the first summer, but it is not seen in *Coccyzus* nor in *Saurothera*, even in old birds, so that this character must be a thing dependent upon conditions, being so variable in nearly related types. The most remarkable thing of all, however, is this, namely, that whilst these parts are completely ankylosed in the young Cuckoo, in the hinder half of the sacrum of an old bird the sutures are quite distinct. This is a phenomenon of the same nature as the re-segmentation in the adult of the last sacral of the young bird to increase the number of the free caudal vertebræ, a very common thing in the higher birds [1].

The first three sacrals are not yet ankylosed by their centra in the youngest specimen, and the 1st only is partly distinct in an

[1] I cannot leave this part of my description without remarking that this must be part of some general law with regard to the evolution of the higher kinds of birds. Intense ossification is the thing we are most familiar with in the osteology of birds, as compared with other Vertebrata. And yet the birds that are manifestly *most* archaic are often most intensely ossified: thus, to take a single fact, an archaic bird is often, not always, desmognathous, whilst a more specialized, newer, and nobler bird of the same family will be schizognathous.

adult bird. The 2nd and 3rd have strong fused riblets, 4 millim. long, and the whole vertebra is 15 millim. across. Here is a *sub-extinct* type with three pairs of buttresses, or, in other words, three pairs of dorso-lumbar vertebræ, covered by the *pre-ilia*; in *Chauna* there are *eight* such vertebræ.

The three next have only upper transverse processes (diapophyses); these, and those of the first three are all fused together above, and also to the ilia. Fenestræ appear behind; there are four pairs of these between the upper transverse processes of the last five vertebræ, all the rest of the roof is plastered over with thin bone—an ossified "aponeurosis."

The 7th sacral has a small pair of inferior bars or riblets, in my older specimens, but these are not visible in the younger; but they make very little difference to the general concavity, right and left of the fused centra; the 7th vertebra is the 1st *urosacral*. The 7th urosacral, or last general sacral, is the widest across its transverse processes, it is 30 millim. wide; the first of that series is only 13 millim. across. The 9th, 10th, and 11th sacrals are carinate, below, the 12th and 13th recover their width, and these are not quite ankylosed together, even in the older specimen.

The general concavity right and left of the ankylosed centra, which is filled by the emerging nerves and the lobes of the kidneys, is not closed in behind, as in many birds, by rib-like thickness of the post-ilia, and special enlargement of the transverse processes of one or more of the urosacrals.

Here we have the general open or unenclosed condition of the under surface, behind the "pre-iliac buttresses," that is seen in the Toucan aud the Woodpecker, a somewhat common state of things in birds with a rather short, broad, and gently convex pelvis, such as many of the Coccygomorphæ possess. Unlike this state of things, we see in *Corythaix* and *Geococcyx*, as in the Raptores, a remarkable closing in of these concavities, by the special growth of post-ilia and the hinder urosacrals.

Behind their middle, the series of the seven *caudal vertebræ* (*cd.v.*) gradually shorten their transverse processes, which become wider as they shorten; the last free joint is 15 millim. across, the 1st is 29 millim., a little less than the width of the last sacral. A rudimentary chevron bone is seen on the 4th, and a large growth of this kind is present on the 5th, 6th, and 7th. The latter or compound bone is 24 millim. long, slender, and subfalcate, being arched somewhat on its sharp dorsal edge. The ventral edge is thick, but sharpens out behind, where the bone is somewhat lobate, and from 2·5 millim. becomes 3 millim. across in front; this bone is 7 millim. deep, it is evidently made up of 5 or 6 rudiments.

Towards the end of the caudal series the *procœlous* joint is established once more, and in the last of these articulations the *joint-cavity* is as complete as in the *occipito-atlantal* articulation; this is a common character in arboreal birds with a large and very mobile tail.

The sacral and caudal series both measure 48 millim. in length;

the 13th sacral is identified as such by its close union (ankylosis) with the postero-superior angles *of the post-ilia*; its centrum is distinct from that of the 12th.

Here, in this manifestly archaic bird we have, as in the Parrot tribe, a marvellous variety in the articulations and functions of the vertebral centra.

The *atlas* is procœlous, and its joint, behind, with the *axis*, is flat, with a joint-cavity. The joint-cavity, with a perforated *meniscus* and a *suspensory* ligament, is seen up to the sacrum; but the cervicals, only, are cylindroidal; the dorsals are opisthocœlous. Then the sacrals are ankylosed, and behind these come the caudals; which, in front, are subconcave on both faces, and are united by fibro-cartilage without a joint-cavity; whilst in the hinder part of the series that cavity reappears in a procœlous joint.

IV. *The Sternum and Shoulder-girdle.*

The *sternum* (Plate XVIII. figs. 7, 8) belongs to the same type as that of *Caprimulgus* on the one hand, and *Buceros* on the other, but is most like that of the latter. Like the *pelvis* it is short and broad, and it has only two notches; they are wide and rounded, and the xiphoids are all three finished behind by a large rounded plate of cartilage. The whole structure is light and rather feeble, and the bone is pneumatic. The coracoid grooves nearly meet; they form together little more than a right angle; between them there is a short, blunt, *inferior* rostrum (*r.st.*), scooped above and carinate below. Together, the *pre*-costal process (*pc.p.*) and the costal edge form a high, nearly equilateral triangle; there are four transverse condyles for the sternal ribs; the first of these only leaves a pre-costal tract 3·5 millim. in extent. The body of the bone is deep and the keel large, with its fore margin at a right angle with the body; in front, the keel projects a little at its lower third, where the lesser pectoral muscle ends behind; it ends 4 millim. in front of the ossified part, and about 13 millim. from the end of the middle metasternal cartilage (*middle xiphoid*). The whole structure, shoulder-girdle and sternum, is much like that of the Barn-Owl (*Strix flammea*), with its single notch right and left behind, the inner notches being nearly obsolete; that bird also has similar long scapulæ and coracoids, and the furcula are not unlike.

This peculiar isomorphism with the Owl is manifestly adaptive; I question if this bird is nearer akin to an *Owl* than it is to a *Cormorant*.

The structure of the sternum is in great contrast to that of the Common Goatsucker; in respect of its general *finish* it is more archaic. The comparative measurements are as follows:—

	Axial length. millim.	Breadth in front. millim.	Breadth behind. millim.	Length of keel. millim.	Depth of keel. millim.
Caprimulgus ..	27	16	25	32	12
Steatornis ..	58	43	52	45	18

The notches in *Steatornis* measure 9 millim. axially and 15 millim. transversely; the arrest of the keel, behind, is not seen in *Caprimulgus*.

The scapulæ of *Steatornis* (Plate XVIII. fig. 8, *sc.*) are 50 millim. long, 5 millim. broad at their widest part, and 3 millim. in the middle; they are elegantly xiphoid, and have a sharp decurved point. The coracoids (*cr.*) are also long; their length is 38 millim., the upper, or fifth, 8 millim.; at their largest (epicoracoid) angular expansion they are 15 millim. across, and only 3·5 millim. in the middle of the elegant and slightly sigmoid shaft; the *clavicular process* (root of precoracoid) is very small.

The furcula (*fr.*) is strong and U-shaped; in a straight line from the apex to their lower junction the rami measure 37 millim.; their average growth is 3 millim.; it is very uniform.

There is a small interclavicular knob (*i.cl.*), 2 millim. high, behind the junction of the rami.

The aborted "precoracoid" segment of cartilage has added very little to the apex of each ramus.

The curve of the rami (*cl.*) is great, and the roundness of the space where they meet below is perfect; it is a typical U-shaped furcula.

This is one of the most common forms of the furcula, not only in the great and varied group of the Coccygomorphæ, but also in Birds generally. Outside the Passerines, in the Arboreal groups, this form is very common, *e. g.* in Trochilidæ, Cypselidæ, and in *Podargus, Eurystomus*, and Bucerotidæ; whilst *Rhamphastos*, with its divided rami, and the Picidæ and most of the Alcedinidæ, have Passerine apices to their rami, that is they are dilated or bilobate.

V. *The Wing.*

The extreme slenderness of the bones forming the wing of *Steatornis* (Plate XX. fig. 1) is in great contrast with what we see in the Bucerotidæ, with their dilated and cellular bones.

The relative length, however, of the three *regions* is very similar in both, the *humerus* and the *manus* being both very short, the *cubitus* very long.

Thus, although this bird, like the Swifts and Humming-birds, has its wings *twice as large* as its legs, it is not a *Macrochire*; its *hand* is very small.

The following measurements of the region in several long-winged birds will make this plain; the *meaning* of these differences will be self-evident when the mode of flight of each type is considered:—

	Humerus. millim.	Ulna. millim.	Manus. millim.
Steatornis caripensis	72	106	82
Buceros ruficollis	102	147	85
Caprimulgus europæus ..	35	45	50
Cypselus apus	12	18	43
Strix flammea..........	80	88	75
Larus canus	92	102	102

It will be seen at once that the intensest specialization has occurred in the Swift, where the humerus is only two thirds the length of the ulna, whilst the manus is more than three and a half times as long as the humerus.

In *Steatornis*, on the contrary, the humerus (*h.*) is seven eighths the length of the manus, whilst the former is only two thirds the length of the ulna, and the manus less than four fifths.

Caprimulgus is intermediate between these two extremes; its *wing-regions* increase in size in a regular manner (from above downwards); it is a sub-typical "Macrochire."

Buceros is the most remarkable in one respect; its manus is only four-sevenths the length of its ulna.

In the two good instances of birds with a light buoyant flight, the White Owl and the White Gull, the greater length of the ulna as compared with the humerus is similar in both birds; but the Gull has its ulna and manus of the same length, whereas in the Owl the latter is only six sevenths the length of the ulna or cubitus.

All these birds have to be considered separately in their various modifications, and no inference as to their *genesis* made rashly from some one or more similarities in their adapted structures.

I might have included *Podargus humeralis* amongst the birds whose wings were measured; but it gives me little help in seeking to find the affinities of *Steatornis*. *Podargus* appears to me to be more allied to *Eurystomus*; its sternum and pelvis differ greatly from those of this Neotropical bird, and its wings are more normal in the relative length of the three regions. Thus the humerus in *Podargus* is 74 millim. long, the ulna 88 millim., and the manus 68 millim.

The relations of *Podargus* must be sought for in the Australian Region and the Eastern Notogæa, generally; those of *Steatornis* in the Neotropical Region; whilst the true Goatsuckers, or Caprimulgidæ, must find their ancestors where they can. I cannot see my way to "father them" on either *Steatornis* or *Podargus*; yet both of these types may possibly be not unlike the birds that, during time, have been specialized into the true Goatsuckers.

I can only find a pneumatic foramen in the humerus (*h.*); that bone is quite normal; its upper crest for the insertion of the great pectoral muscle is large, and the dilatation below is hooked inwards, hollowed out and perforated to let in the air. The distal condyle is well developed, and there is above it, on the flexor side, a semi-oval hollow for the origin of the flexor muscles[1].

The long, slender, gently sigmoid radius (*r.*) and arcuate ulna (*u.*) are quite normal; the latter is marked very slightly for the secondary quills. The radiale and the ulnare are also well developed and perfectly normal; I see no "sesamoids" attached to them. The top of the manus has the large 2nd distal carpal ($d.c.^2$) over the large middle metacarpal, the lesser 3rd distal carpal ($d.c.^3$) on the outer side of the top, and the 1st distal carpal (Plate XX. fig. 2, $d.c.^1$) is seen as a knob looking towards the 1st metacarpal, but ankylosed to the 2nd.

[1] Mr. Frederic A. Lucas finds an "os humero-capsulare" in this bird (see Plate XX. fig. 1, *o.h.c.*).

The three metacarpals ($mt.c^1$, $mt.c^2$, $mt.c^3$) form together the usual main part of the manus; the interosseous space is large and uncovered above. The single phalanx of the 1st digit ($dg.^1$) has no rudiment of a second joint; the distal phalanx of the 2nd ($dg.^2$) has a small seed-shaped remnant of the ungual phalanx; the penultimate or 2nd phalanx of the 2nd digit is slightly longer and also narrower than the phalanx of the 1st digit. The single phalanx of the 3rd digit is the least of the three; it shows no signs of a second joint.

The oblong proximal phalanx of the 2nd digit has a slight perforation in its thin dilated distal part.

Above, returning to the head of the manus, I find a considerable thickening of the projecting shoulder of the 1st metacarpal. Also, on the extensor face of the 2nd metacarpal (close to the top of the interosseous space) there is an oval elevation 2 millim. long, due to the presence in the embryo of an intercalary metacarpal ($mt.c.^{2'}$).

Also, on the flexor face of the 3rd metacarpal, above the interosseous space there is a similar but less-marked elevation, which is possibly due to a rudiment of the 4th digit; as a cartilage it is very constant in several families of birds in an early stage.

Large as these wings are, they nevertheless suggest the idea of *feebleness*; *they are like the bones of a bed-ridden person*, slender, smooth, and very light; is not this due to the extremely torpid habits of the bird, which only spends a very limited time in any active exercise? that exercise being simply eating. The extreme *fatness* of this bird favours this view of the case.

VI. *The Hip-girdle and Hind Limbs.*

A few measurements will show the special form of the pelvis in this type (Plate XIX. figs. 2, 3, and Plate XX. fig. 6); that part can now be studied as a whole—the hip-bones and sacrum together.

This pelvis may be compared with that of *Ceryle alcyon* and *Caprimulgus europæus*; it is most like that of the former, and has a rudiment of the peculiar spur seen on the side of the pre-ilium in Kingfishers; it is very wide.

In *Caprimulgus* and *Podargus* the pelvis is narrower.

	Length of pre-ilium. millim.	Length of post-ilium. millim.	Breadth across pre-ilium. millim.	Breadth across tro-chanters. millim.
Ceryle	17·5	16·5	16	28·5
Caprimulgus ..	15·5	10·5	10	21·5
Steatornis	25	34	30	48

The width across the pubis, below the greatest interpubic breadth, is, in *Ceryle* 33 millim., in *Caprimulgus* 23 millim., and in *Steatornis* 53 millim.

One thing to be noticed is, that whilst in many Cuculines the "pre-pubic spike" is absent, *e.g.* in the Alcedinidæ and Caprimulgidæ

(*Caprimulgus* and *Chordeiles*), there is a rudiment in *Steatornis*, in *Cuculus canorus*, and in *Buceros ruficollis*; this part is nearly *as large in Geococcyx affinis* as in *Apteryx*.

In *Ceryle alcyon* the post-ilium sends backwards a process (its proper termination) over the ischium, which only measures 1·5 millim.; this spur is very long in *Steatornis*; it is 10 millim. in length; the ischium and pubis both project far backwards also as long ligulate processes, cartilaginous for their greater part. The pre-ilium (*pr.i.*) in *Steatornis* sends forwards a spike in front of the ear-shaped fore lobe of the bone; this is formed by the junction of the inner edge of the bone with the diapophysis of the underlying vertebra—the 1st sacral.

The "sacro-ischiadic" fenestra (*s.i.f.*) is oval; it is 8 millim. long by 4 millim. wide; its broad end is in front. The bony junction of the post-ilium (*pt.i.*) and ischium, behind this fenestra, is 1·5 millim. in extent.

The *ischium* (*isc.*) runs back quite free from the pubis (*pb.*); it keeps at a distance from it; its whole length is 38 millim., and its free projection, next below that of the post-ilium, is 13 millim. long; it is 6 millim. wide in front of the fore part.

The *pubis* is only 2 millim. wide in front and 3 millim. behind; its whole length is 47 millim., and the chord of the arc formed by this rib-like bone behind and the pre-ilium in front is 74 millim.

This is a peculiar form of pelvis, so broad, gently convex, and free from all strong outgrowths; it is only in birds whose hind limbs are small and feeble, such as Cypselidæ, Trochilidæ, Alcedinidæ, and the like, that such a pelvis is possible. Even among the Cuculines, whenever the legs are strong, we get a great contrast to this, *e.g.* the Musiphagidæ, and such Cuculidæ as *Saurothera* and *Geococcyx*.

The *Hind Limbs* (Plate XIX. figs. 4, 5) of *Steatornis* are, as I have said, only half as large as the wings; I here compare them, in the measurement of the main regions, with those of the Kingfisher and Goatsucker:—

	Femur.	Tibia.	Tarso-metatarsus.	3rd digit.
	millim.	millim.	millim.	millim.
Ceryle alcyon	29	39	12·5	24
Caprimulgus europæus	21·5	29	14	20
Steatornis caripensis..	38	48	17·5	37

Here we see that, roughly speaking, the femur (*f.*) is three fourths the length of the tibia (*t.*) in *Ceryle* and *Steatornis*, and a little more than two thirds in *Caprimulgus*.

The tarso-metatarsus (*t.mt.*) is little more than half the length of the 3rd digit in *Ceryle*, more than two thirds in *Caprimulgus*, and considerably less than half in *Steatornis*.

The relative size of the bones of the leg and foot, on the whole, in the last of these birds is very similar to what we find in the Cypselidæ, Caprimulgidæ, and Alcedinidæ; for in all these families the hind limb is very feebly developed. This is very marked also in

Steatornis; and the shape and strength of its leg-bones are in great contrast to what we see in such Fowl-like Coccygomorphæ as the Musophagidæ and the Ground-Cuckoos.

The *femur* (*f.*) of *Steatornis* is, perhaps, the straightest to be seen in the Class; the breadth is 8·3 millim. above and below, and it narrows to a diameter of 3·5 millim. in the middle of its shaft. The condyloid ledge for the feeble *fibula* (*fb.*) is not well-marked; that bone is a little above half the length of the *tibia*, which latter bone is as straight and *primordial* as the femur; it would seem as if these bones had not altered *in shape* since the middle of incubation. The breadth of the head of the tibia (*t.*) is 9 millim., across its tarsal base 8 millim., whilst the middle of the shaft is only 3 millim.

The *cnemial ridges* are very rudimentary, and the ridge outside for the fibula (*fb.*) only reaches 15 millim. downwards.

A thin delicate tendon-bridge exists in front of the base of the tibia below (Plate XX. fig. 4); but there is no special depression between the astragalar and calcaneal regions of the condyle, for the intercondyloid knob on the distal tarsal (or head of the shank) is nearly obsolete (Plate XX. fig. 3). The inner part of the condyle is formed by the astragalus, and the outer by the os calcis; there is a rudiment of the intermedium between them; the *centrale*, or "naviculare" (*nv.*), is seen as a cartilaginous, curved wedge behind the joint. The tarsal outgrowth behind the head of the shank to form a tendon-canal for the *plantar tendons* (Plate XX. figs. 3, 5) is open. This part is closed in, and forms one canal in *Ceryle alcyon*; in the Martin (*Chelidon urbica*), as in *all* the Coracomorphæ, there are *five* canals in the compound mass; in the Swift (*Cypselus apus*) there is an unusual thing—a little bridge in front of the distal tarsal; but the two ridges *behind* are not united[1].

There is a notable peculiarity in the structure of the *inter-tarsal* joint. The condyloid trochlea formed by the astragalus is large and perfect, and rolls in a well-formed concavity on the inner side of the great distal tarsal. But the calcaneal part of the double trochlea is feeble (Plate XX. figs. 3–5) and the outer part of the facet on the lower tarsal is almost flat[2].

The tarso-metatarsus shows the signs of division into three main metatarsals, both above and below, 2nd to 4th (Plate XIX. figs. 4, 5). The free distal piece that carries the "hallux" (*mt.t'.*) is 5·5 millim. long.

On the outer side of the head of this small shank the 5th *metatarsal* (*mt.t.* 5) can be seen as a club-shaped rudiment, fused with

[1] The classification of birds by the palate is very useful as a *help* to other methods, everything else being taken into account. Nowhere does it show its value more than in the Coracomorphæ; they are all "Ægithognathous"; but the Ægithognathæ and the Coracomorphæ are not equal groups—the former is too large for accurate superposition on the latter; the Swifts (Cypselidæ) are Ægithognathæ, but they are not Coracomorphæ.

[2] This obliquity reminds one of that in the free astragalus itself in the Megatherium, as compared with the same bone in the Horse, the latter having the condyle in two nearly equal, oblique semicircular elevations, whilst in the former the two convexities are extremely unequal.

the distal tarsal over the 4th metatarsal; it is 1 millim. across, and runs downwards 2·5 millim. The whole tarso-metatarsus is less than half the length of the femur and little more than one third the length of the tibia. It is much like the same part in the "Ornithoscelida," except for the fusion of its elements. The breadth, below, across the condyles for the four digits is 11 millim. nearly, two thirds as much as its whole length, namely 17·5 millim. The condyle for the 1st is 4 millim. higher up than that for the 3rd digit. The whole series of metatarsals in the distal part of the shank are curiously twisted backwards, from without inwards, so that all the condyles lie nearly on the same oblique plane; this is a very *Cypseline* state of things. The breadth, above, of the small tarso-metatarsal is 6·5 millim., in the middle 4 millim. The condyles are all grooved, the groove is deepest on that for the 3rd digit.

The length of the digits (Plate XIX. figs. 4, 5, *dg.* 1–4) is as follows:—1st, 17 millim.; 2nd, 30 millim.; 3rd, 36 millim.; and 4th, 33 millim. The proximal phalanges increase in length and thickness, gently but sensibly, from without inwards, in a very regular manner. The proximal phalanx is shorter than the penultimate in the 3rd and 4th digits; the two are equal in the 2nd; in the 4th the 2nd and 3rd phalanges are not so long *together* as the 4th or penultimate; this is a rare structure. The claw-joints are strong and well-curved.

VII. *Summary.*

The Guacharo (*Steatornis*) is not the only Neotropical type that asks to be put into a separate suborder, such as that which Professor Huxley (Proc. Zool. Soc. 1868, p. 311) has constituted for the Hoatzin (*Opisthocomus cristatus*).

If it were allowable, the term "Heteromorphæ" should be kept for all those birds that cannot be classified: that refuse to be put into any of our normal groups. We should then have a "Cave of Adullam" for all those waifs and strays from the old Avifauna; birds that, like the Flamingo, the Palamedea, and the types just mentioned, cannot be bound up with the other bundles, because the cords that keep the normal birds into such a neat ornithological order will not tie when bound round these abnormal forms, even if carried round them *nine times*!

When, as in *Steatornis*, only one species is still living of an evidently isolated type, the inference is at once made that here, if anywhere, we have an Archaic kind of bird. I think that I have made it clear in the foregoing description that this is really the case in this instance.

There is one difficulty in this kind of research, namely, that in those types that are evidently Archaic, we meet with *some* characters that are seen at once to be the result of the very last or newest specialization that this type of skeleton has undergone.

Of course *Steatornis* has had *as much time* to do this in as any other bird; but, whilst belonging to a *conservative* and almost *extinct* family—extinct but for it, the Oil-bird has some characters that are only present in birds that have arrived at the highest state of ornithic modification and perfection.

In the self-same skull we have then, as I have shown, a basis cranii with large backwardly placed "basi-pterygoids" that are nearly Struthious; the only carinate bird that is a rival to *Steatornis* in this respect is Pallas's Sand-Grouse (*Syrrhaptes paradoxus*) (see Trans. Zool. Soc. vol. v. pl. xxxvi.).

On the other hand, the "ethmo-nasal wall" has been completely broken through and thus a complete hinge of the face on the skull has been formed exactly as in the Parrots, where the mobility of the upper face is at its greatest possible perfection. But the basis cranii of the Parrots, in harmony with the "palato-quadrate" arcade, is in the highest state of modification; no bird is so far from the old *quasi-reptilian* Ratitæ in this respect as the Parrot.

Yet, as a set-off against this, whilst the Archaic Ratitæ have all their pre-sacral vertebræ in the highest ornithic perfection, namely, *cylindroidal*, in the Parrots the dorsals are opisthocœlian; so they are as we have seen in *Steatornis*, which also has the rare condition, as in *Hesperornis* and the Grebes, of perfect rib-bars on the axis [1].

In Wading and Water Birds this state of things is common, *e.g.* in the Penguins, *Alcine* Divers [2], Gulls, and *Limicolæ*; but the Psittacidæ and *Steatornis* are the only high-class arboreal birds in which I have found this character of opisthocœlous dorsals.

Here I may remark upon a most puzzling fact with regard to both old and new kinds of birds, namely, a *prolepsis*, or anticipation, so to speak, of Mammalian characters, in certain birds—a similarity or isomorphism rather, for here "genetic affinity" has no place.

The more Archaic the type of any one of the existing Ratitæ, the more complex is the *nasal labyrinth*, quite similar in its complex "outgrowths" to what we see in a mammal. The very dorsal vertebræ that are *ancient* or opisthocœlian in a Parrot, are also like the vertebræ of a Mammal—they have *thin terminal epiphyses.*

In by far the noblest of all birds, the Crows and Songsters, the form of palate which gives them their *morphological name*, "Ægithognathæ," is quite similar to what is seen in the Marsupials and low Insectivorous Mammals.

In this very bird, *Steatornis*—as in *Podargus*, the larger Bucerotidæ, and in certain Ducks and Swans—there is a degree of *double Desmognothism* quite similar to that which exists in the Marsupialia.

Hence we had better, at present, speak of these things as cases of *isomorphism*, or similarity—confessing our ignorance of their meaning—than rashly to set them down to genetic relationship.

By taking this character or that, and closing the eyes to the other characters seen in *Steatornis*, we might find many a relation for it: it is, nevertheless, a friendless bird, I cannot find a near relation for it. And this is the more evident if we consider that the forms that apparently come nearest to it are Eastern and Australian types,

[1] In typical Chenomorphæ—Geese, Swan, Ducks—the *atlas*, also, has its rib-bar complete, and a separately ossified rib.

[2] Not in the Loons and Grebes.

such as *Eurystomus* and *Podargus*; not the inhabitants of its own region.

The same thing is to be seen in several other types: *Dicholophus*, a Crane-like bird of prey, represents the Ethiopian Secretary-bird; the Boatbill (*Cancroma*), the great Balæniceps of the Soudan; and even the Tinamous, which are so closely related to the Ratitæ, look more towards *Apteryx* than towards *Rhea*. These, however, are a few facts which are mere samples of a very large number, and the organic types generally that lie beyond "Wallace's Line" in the East, are to be compared with those that are from beyond the Isthmus of Panama in the West.

As to the group to which *Steatornis* belongs, I think that at present the best thing to do is to drop some of Professor Huxley's smaller group-terms, and to retain these for larger gatherings of birds.

If his "Cypselomorphæ," for instance, are allowed to fall back into the great and most important group of the Coccygomorphæ we shall get over many difficulties and have a suborder comparable to the Coracomorphæ.

These two groups, so constituted as to take in, in the latter, all the Ægithognathæ except the Swifts, and the former be made to hold within one ideal boundary-line all the non-passerine arboreal "Altrices" (except the *Pigeons* and *Raptorial birds*), all the "Tenuirostres," "Fissirostres," "Syndactyli," and "Zygodactyli" of Cuvier,—then the likeness or the unlikeness of the two groups will shine out clearly.

In the Coracomorphæ we have 6000 species, that, by their most amazing uniformity, suggest to the Evolutionist one common parentage, and in that group only a small percentage of types is abnormal. In some characters, both of the skeleton and of the soft parts, there is an absolute uniformity. I know of no case in which the cæca coli are absent; and from the Corvidæ proper to the Pteroptochidæ, the *most variable part of the skeleton*—the *manus* and *pes*—the distal part of both fore and hind limbs, are uniform throughout. The carpo-metacarpus has, in every skeleton I have seen, a bony bridge *over* the proximal part of the interosseous space formed by ankylosis of an ossified cartilaginous plate, which is in reality an *intercalary metacarpal*. Also in none, except the Bank-Swallow, have I found a developed *ungual phalanx* to the 1st or 2nd digits; they almost always abort or suppress the 2nd phalanx of the 1st, and the 3rd phalanx of the 2nd digit.

In the leg, the tarso-metatarsus always, so far as I have seen, has *five* tendon-canals behind its head. There is no finished canal here either in *Steatornis* or in *Cypselus*; in the Common Fowl there is one passage—a common state of things.

Then, as I have said, in the skull there is always that peculiar modification of the Schizognathous palate which Professor Huxley calls the Ægithognathous type.

Also, except in rare cases, the basipterygoids are *nearly suppressed*; only in a few cases are they seen even as thin prickles, in the adult. In all cases that I have examined there is, in all young birds, a large remnant of the *old larval* palato-quadrate cartilage, the cartilaginous post-palatine; this is a correlate of the Ægithognathous fore palate, and is seen in Swifts.

Only in a few, just the small family of the Pteroptochidæ, has the sternum *four* notches on *one side*; I long ago saw an additional notch in the Blue-tit (*Parus cæruleus*) ('Shoulder-girdle and Sternum,' pl. xvi. fig. 1).

The "interclavicle" is marvellously uniform in the Passerines; it nearly dies out in some few Australian forms.

The *range of size* is considerable, from the Raven to the Nectar-bird, but far less than in the Coccygomorphæ, if the Humming-birds are taken into that group.

These are a few of the things that show themselves, either throughout, or nearly throughout, the Coracomorphæ. These birds do break down as to their *syrinx*; both in the Eastern and in the Western *Notogæa* there are forms that fail to be true Oscines. But these *Tracheophonous* and *Haploophonous* types form a very small percentage of the whole.

Such a *syrinx* as is seen in the vast majority of this huge assemblage of birds is seen *nowhere else*; no other bird has an equally *complex* and *perfect* second larynx; the Parrots come nearest to them in this respect; and outside the Passerines the Parrots are the highest and most specialized of all existing birds.

Now if we survey the Coccygomorphæ after the "Cypselomorphæ," "Celeomorphæ," and "Psittacomorphæ" have been taken in, we shall, indeed, find a contrast in these two great suborders.

In the first place this "mixed multitude" only contains about a fourth of the number of the uniform Passerines; but they are *ten times* as polymorphic.

Taking the characters just mentioned in the Coracomorphæ in order, we find that the *cæca coli* are extremely variable; in the Ægithognathous Swifts they are suppressed, also in the Rhamphastidæ and Picidæ; sometimes they are large, as in the Cuckoo and Goatsucker.

The *manus* shows the *interosseous bridge* perfect, and completely ankylosed with the 2nd and 3rd digit in *Picus*, *Rhamphastos*, and *Alcedo*; in the Swift it is gone, in the Trochilidæ it is half as large as in the Passerines, and free on its outer edge.

The *pes* does not show, in any case that I know of, the *five* tendon-canals; there is a single canal, as a rule, and this may be open behind,—only covered with membrane.

The *palate* in this group, instead of being uniform, shows *six* different modifications, namely:—

1. Ægithognathous—Cypselidæ.
2. Saurognathous—Picidæ.
3. Schizognathous—Trochilidæ, Trogonidæ, Caprimulgidæ (part).
4. Indirectly Desmognathous—Coliidæ.

5. Directly Desmognathous—In the majority of Families.
6. Doubly Desmognathous—*Podargus*, *Steatornis*, Bucerotidæ (part).

Of course the first three are *varieties* of the Schizognathous type, as the last three are of the Desmognathous.

The basipterygoids vary from complete abortion in the adult, almost total suppression (in the Swift), to a very high state of development, almost Struthious, in *Steatornis*. They are large and far forwards in the Trochilidæ, and large in the middle region in the Trogonidæ.

The *endoskeletal* post-palatine rudiment is just dying out in the Caprimulgidæ, and it is in *Caprimulgus europæus* that I have found the greatest approach to *Ægithognathism*; the large vomer is formed from a pair of centres, but it is only united to the nasal floor by ligament; in the Swift the Ægithognathism and the post-palatines are seen.

The sternum takes on almost every possible modification in the Coccygomorphæ; it may have an entire hind margin, as in the Trochilidæ and Cypselidæ, or one or two pairs of notches.

The interclavicle is almost as large as in the average Passerines, or even in the Gallinaceæ, in *Piaya cayana*, *Geococcyx affinis*, *Coccyzus americanus*, and *Cuculus canorus*; it is present but small in *Saurothera vieilloti*; all these are true Cuculidæ.

In the Picidæ and Alcedinidæ and others the interclavicle is suppressed; in the Toucan, some of the Hornbills (*e. g. B. albirostris*), and in *Corythaix* the rami do not unite; they do in many of the Psittacidæ, but the *top*, only, of each "ramus" remains in some forms; the top of the ramus is double, as in the Passerines, in *Picus*, *Rhamphastos*, and *Alcedo*.

The *syrinx* is extremely variable in this group, from its lowest form in the Swift to a very high, but not the highest, in the Parrot. In some of the Cuculidæ the trachea is double a long way up, quite like what is found in the Chelonia (see Beddard, P. Z. S. 1885, pp. 168–187).

Nevertheless all these varying forms are, in some unknown way, related, and related most intimately. You cannot cut up the group without violence; at their *upper margin* they interdigitate with the great Passerine suborder; any supposed near relationship of the Coccygomorphæ to any other type is, I believe, an illusion; they show in some cases a resemblance to the Owls, and in others, as in the Musophagidæ, to that most abortive and aberrant Curassow, the Hoatzin (*Opisthocomus*); but I feel certain that in these cases there is no true *genetic affinity*, it is merely *adaptational isomorphism*; or, in plain English, similar modification, in different types of birds, to the same kind of life.

The peculiarities of structure in *Steatornis* that are of most interest are those that are shared by it with ancient and extinct Reptilian types. Of course I do not forget that the whole of its organism is in a certain sense *Reptilian*; but although the bird grows up from an essentially Reptilian "root," yet the various parts are marvellously transformed, and the bird itself has gained a far higher structural and physiological level than that of even the highest and most modern Reptile.

Here, however, in *Steatornis*, we find the ancient structures built up within the modern; it is not a perfectly typical bird, but is *composite*, so to speak, a type made of things new and old.

The Singing-birds, including, of course, the large Crows, have, more than any other birds, put away the old leaven of the low Reptilian nature that they started with; yet in them, as I have shown, the *old materials* are sometimes built up into, but hidden by, the transformed, newer parts.

But here, in this bird, the hinder part of the pre-sacral chain of vertebræ has its articulations of the opisthocœlian kind, as in Archaic Reptiles. Its palate, also, has just the same degree of Desmognathism as the Green Turtle (*Chelone viridis*); and it has more *free* cervical ribs than any other known bird.

Its tarso-metatarsus is but that of an Ornithoscelidan Reptile, just masked by ankylosis of certain parts; it is in an arrested condition as compared with that of any Passerine bird.

All birds living, both Ratitæ and Carinatæ, come nearer the Amphibia than any kind of existing Reptiles in the foundations of the cranial superstructures; the "parasphenoid" is very large and Ichthyopsidian in all these supra-reptilian types.

But the Oil-bird, like a few more of the Carinatæ,—Musophagidæ, Procellariidæ, &c.,—has in its fore palate the triradiate remnant of the fore part of the Amphibian palato-quadrate; it clearly shows, in the adult, the "ethmo-," "pre-," and "post-palatine" bars.

The conclusion to be drawn from facts of this kind is, surely, not that Birds are to be imagined as arising from the Reptiles, proper—the cold-blooded "Amniota"—either by the utilization of sudden "sports," or by a slow, secular adaptation of Reptilian structures to the necessities of a flying creature, this flying creature becoming hot-blooded, quick-tempered, intelligent, vocal, and loving.

Rather, it seems to me, to point out that the origin of the Bird must be sought for, by the "scientific imagination," among low and quasi-larval forms, similar to those with which we are acquainted in the larvæ of existing Amphibia and Fishes, and similar to, *and near relations of*, other low Chordata, that gave rise to the Reptiles.

The low and simple types from which we may suppose the Mammalia to have arisen could not have been so nearly related as those from which, *by the mystery of transformation*, the Reptiles and Birds had their origin.

Although hot-blooded, the lowest kind of Mammals—the Monotremes—are in some parts of their organization on a level with such Archaic Reptiles as the *Ichthyosaurus* (for example in their shoulder-girdle); yet in the formation of their *mouth* and *middle-ear* they are quite unlike both Reptiles and Birds; and show in a rough and unfinished form the same morphology of these parts as is found in our own Skull.

EXPLANATION OF THE PLATES.

List of Abbreviations.

The Roman numerals stand for nerves or nerve-foramina.

ac. Acetabulum.
ag. Angulare.
al.e. Aliethmoid.
al.n. Alinasal.
al.s. Alisphenoid.
al.sp. Aliseptal.
ar. Articulare.
at. Atlas.
a.t.r. Anterior tympanic recess.
ax. Axis.
b.hy. Basihyal.
b.h.br. Basi-hyobranchial.
b.o. Basioccipital.
b.pg. Basipterygoid.
br. i. 1st branchials (cornua majora).
b.s. Basisphenoid.
b.t. Basitemporal.
c. Centrale and centrum.
cd.v. Caudal vertebra.
c.f.c. Cranio-facial cleft or hinge.
c.hy. Cerato-hyal.
cl. Clavicle.
cr. Coracoid.
c.v. Cervical vertebra.
c.v.a. Canal for vertebral artery.
d. Dentary.
d.c. Distal carpal.
dg. Digit.
d.v. Dorsal vertebra.
e.cth. Ectoethmoid.
e.n. External nostril.
e.o. Exoccipital.
Eu. Eustachian opening.
f. Femur.
fb. Fibula.
fbe. Fibulare.
f.m. Foramen magnum.
fr. Furcula.
h. Humerus.
i.c. Internal carotid artery.
i.cl. Interclavicle.
il. Ilium.
i.m. Intermedium.
i.o.f. Interorbital fenestra.
i.r. Intermedio-radiale.
isc. Ischium.
j. Jugal.
l. Lacrymal.
lc. Lacrymal canal.
mc.c. Metacarpus.
m.st. Metasternum.
mt.t. Metatarsus.
mx.p. Maxillo-palatine.
n. Nasal.
n.px. Nasal process of premaxillary.
n.s. Neural spine.
nv. Naviculare.
ob.f. Obturator foramen or fenestra.
oc.c. Occipital condyle.
od.p. Odontoid process.
o.h.c. Os humero-capsulare.
o.s. Obturator space.
o.u. Os uncinatum.
p. Parietal.
pa. Palatine.
pa.s. Parasphenoid.
pb. Pubis.
p.e. Perpendicular ethmoid.
pg. Pterygoid.
p.p. Pars plana.
pr.i. Pre-ilium.
pt.i. Post-ilium.
pr.z. Pre-zygapophysis.
p.s. Presphenoid.
pt.z. Post-zygapophysis.
p.u. Processus uncinatus.
q. Quadratum.
q.j. Quadrato-jugal.
rd. Radiale.
r. Radius.
r.b.s. Rostrum of basisphenoid.
s.ag. Supra-angulare.
sc. Scapula.
s.i.f. Sacro-ischiadic fenestra.
so. Supra-occipital.
sp. Splenial.
sq. Squamosal.
s.r. Sacral rib.
st. Sternum.
st.r. Sternal rib.
s.v. Sacral vertebræ.
t. Tibia.
t.c. Tendon-canal.
t.co. Tympanic wing of exoccipital.
t.f. Temporal fossa.
t.mt. Tarso-metatarsus.
ty. Tympanic.
ty.c. Tympanic cavity.
u. Ulna.
ul. Ulnare.
v. Vomer.
vb. Vestibule.

PLATE XVII.

		Size of fig.
Fig. 1.	Skull of *Steatornis caripensis*, adult, side view.	1½ diam.
2.	Skull, upper view.	„
3.	„ lower view.	„
4.	Lower jaw, upper view.	„

PLATE XVIII.

Fig. 1.	Skull, end view.	1½ diam.
2.	Os hyoides, upper view.	„
3.	Atlas, front view.	2 diam.
4.	Axis, front view.	„
5.	Last dorsal vertebra, front view.	„
6.	„ „ „ hind view.	„
7.	Shoulder-girdle and sternum, lower view.	Nat. size.
8.	„ „ „ side view.	„

PLATE XIX.

Fig. 1.	Cervical and dorsal vertebræ and ribs, side view.	Nat. size.
1 *a*.	Last four cervical ribs.	„
2.	Pelvis and caudal vertebræ, side view.	„
3.	„ „ „ upper view.	„
4.	Left leg, side view.	„
5.	Part of same, front view.	„

PLATE XX.

Fig. 1.	Left wing, outer view.	Nat. size.
2.	Part of same, inner view.	„
3.	Tarso-metatarsus, top view.	2 diam.
4.	Tibia, lower part, front view.	„
5.	Ankle-joint, side view.	„
6.	Pelvis, lower view.	Nat. size.

2. Preliminary Notes on the Characters and Synonymy of the different Species of Otter. By OLDFIELD THOMAS, Natural History Museum.

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One of the most interesting and at the same time most difficult groups of Mammals is that of the Otters, a group which many zoologists have tried to work out wholly or in part, but which, owing to the striking resemblance of the species to one another, to the difficulties of obtaining large series, and to the variability of the different forms, has remained to this day in a terrible state of confusion, both as to systematic arrangement and nomenclature.

The present paper does not pretend to be anything like a complete monograph of the group, but only attempts to clear up such points in the history of the species as are at present capable of elucidation, while leaving for future investigation many questions which cannot be settled for want of still further material.

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